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placed upon the precise value of the coincidence, it may be noted that this amount, .7, is just what would be expected for a similar distance in the X chromosome of *Drosophila melanogaster* (*ampelophila*).

It should be noted here that Haldane, in referring to my results in a recent article, called attention to the fact that the *Primula* data (using the counts of all classes of plants) fit his formula for expressing the relations between linkage values in *Drosophila*. Inasmuch as any formula expressing the linkage relations in *Drosophila* is necessarily the mathematical resultant of the operation of interference (interference of a type which diminishes with increasing distance), Haldane's statement that the *Primula* data fit the same formula as *Drosophila* is equivalent to saying that interference exists here, as in *Drosophila*; it is in this sense a restatement of my observation that the number of double crossovers found in the total count of the plants is smaller than the number "expected" in a case of a random occurrence of crossing over. It must further be noted that Haldane's formula for expressing the linkage relations in *Primula* is open to the same objection of unreliability as noted above, since his calculation is based upon all classes of plants, instead of upon just those classes which I showed must be used in any reliable determination.

The finding of interference in another organism, so widely separated from *Drosophila*, is of interest because of the bearing of interference on the general theory of linkage. Interference is not accounted for on Trow's form of the reduplication theory, although it was the earlier experiments upon *Primula* itself which largely supplied the data upon which this theory was founded.

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ON INTERSEXES IN FIDDLER CRABS.

Not long ago a few specimens of small female fiddler crabs, *Uca pugnax*, were submitted to me by Professor T. H. Morgan for determination. They appeared to be normal, immature individuals and I so stated in my reply. In order to demonstrate the correctness of this view, a loan was made to Professor Morgan from the National Museum collection of a series of imma-

ture female fiddlers showing different widths of abdomen normal to the growing female in passing from the juvenile or immature, to the sexually mature, condition. However, this exhibit apparently had the opposite effect from that intended, as Professor Morgan pronounced them all "intersexes" and thereby seemingly robbed the female fiddler of its period of adolescence.

In his paper "Variations in the Secondary Sexual Characters of the Fiddler Crab"¹ we find Professor Morgan's exposition of the subject. It is not easy to follow the author owing (1) to erroneous or incomplete references to figures and (2) to absence of measurements; for example, "Fig. 4B," cited on p. 225, line 12, does not exist, "Fig. 4B'," p. 225, line 3, is cited as a female abdomen when it is really a male, and one can not tell if the two unequal chelæ of Fig. 4A belong to one individual, which is probable, and if the two unequal chelæ of Fig. 4B belong to one individual, which is probable but not possible, as the text says that they are "of the same size." There are no measurements nor indication of enlargement of figures.

The case under discussion belongs in Professor Morgan's second category of intersexes. He tells us that the specimens are always small, that they are female in character except for the abdomen being narrower than in the mature female, and the abdominal appendages being different from those of the mature female but not at all malelike. Why, one naturally asks, are they not juvenile? His reply is, "because normal individuals of the same size have the abdomen full width." This argument unsupported is fallacious.

Many species of crabs are known to attain sexual maturity at a much smaller size than their maximum and to exhibit considerable range in the size at which they attain that maturity. As an example, two jars full of the common shore-crab of the Pacific coast, *Hemigrapsus nudus*, show egg-bearing crabs ranging in width of dorsum from 10.4 mm. to 32 mm., and among the immature females with narrow abdomens, six individuals which range from 12.5 to 15.7 mm. in width.

Professor Morgan goes on to say that some of the smallest "intersexes" have the narrowest abdomen, that there is no obvious relation between the size of the crab and the relative width of the abdomen, but that there is some correlation between the character of the abdominal appendages and the width of the

¹ AMER. NAT., Vol. LIV, No. 632, May-June, 1920, pp. 220-246.

abdomen. All these point to normal development as the rational explanation.

He figures, p. 226, the abdomens of five female "intersexes," including, I think, but am not sure, two abdomens of successive, or near successive molts in the aquarium. As no two of these abdomens are of the same width, the illustrations would indicate a change in size of body, that is, growth and surely age, with the molt or molts. But Professor Morgan says, p. 225, lines. 13-14, "that the condition of the abdomen and claws had not changed."

The fact of the matter is, that neither Professor Morgan nor any one else, so far as I know, is aware of the exact growth changes of our fiddler crabs beyond the first few crab stages. Hyman, in "The Development of *Gelasimus* after Hatching,"² carries his painstaking researches only as far as a 4 mm. wide crab stage.

We can at present reason only by analogy from the study of work done on other species of crabs, of which there is altogether too little compared to the facilities offered by the laboratories of our coasts; and such analogy seems to indicate that the crabs upon which Professor Morgan bases his arguments are normal females which had not, in their particular cases, attained sexual maturity. Churchill's "Life History of the Blue Crab"³ may be cited, and also Pearson's "Cancer. (The Edible Crab.)"⁴ Both of these give tables which demonstrate the great variability in the ratio of increase at each act of ecdysis.

It is important, as I have stated elsewhere, that the development of each of our common crabs be carried through from the egg to maturity, that accurate records be made, and properly labeled material upon which such studies are based be deposited in an enduring collection accessible to all who may be interested.

MARY J. RATHBUN

VARIATION IN JUVENILE FIDDLER CRABS

It is too bad that Miss Rathbun's kindness in sending me specimens from the National Museum "had the opposite effect from that intended." While regretting this, I can only call attention to the fact, stated in my paper, that out of more than

² *Jour. Morphol.*, Vol. 33, No. 2, March, 1920.

³ *Bull. Bur. Fisheries*, XXXVI, November 11, 1919.

⁴ *Proc. and Trans. Liverpool Biol. Soc.*, Vol. XXII, 1908.